



California Hydrogen Highway Blueprint

Implementation Topic Team

Sub-team C/S.2c – Vehicle-Station Interface

Implementation Topic Team Public Hearing

August 31, 2004

CalEPA, Sacramento, CA



$$\left[\frac{p^2}{2\mu} + V(r) \right] \psi(r) = E \psi(r)$$

California Hydrogen Highways

www.hydrogenhighway.ca.gov

Sub-team C/S.2c – Vehicle-Station Interface

Scope of Work:

- Identify codes and standards required for station fuel dispenser, hose & fueling nozzle, and vehicle interface.
- Evaluate existing codes & standards
- Provide gap analysis
- Provide recommendations to hydrogen highway



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Fuels:

- Compressed hydrogen [CH₂]
- Liquid hydrogen [LH₂]
- Blended hydrogen/natural gas [HCNG]

Vehicles:

- Fuel cell vehicles [CH₂, LH₂]
- Internal combustion vehicles [CH₂, LH₂]
- Blend fuel buses [HCNG]





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Survey of Current Codes & Standards & New Activity

Current Activity in Hydrogen Fueling Station Codes

- National Fire Protection Assoc (NFPA)
- International Codes Council (ICC)

Current Activity in Hydrogen Fuel Standards

- Society of Automotive Engineers (SAE)
- International Standards Organization (ISO)
- CSA America
- American Society for Testing Materials (ASTM)

California Regulations

- California EPA (CalEPA)
- California Air Resources Board (CARB)



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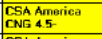
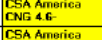
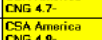
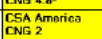


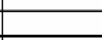



Compressed Hydrogen Fueling

Status:

- Current Codes & Standards surveyed
- Several gaps identified – primarily fueling equipment & protocol - *work is underway to close gaps*

Potential CH2 Recommendations

- Change ARB language on California H2 regulation 2292.7 to “not including fuel cell vehicles”
- Use CaFCP Guidelines until CSA & SAE codes become available
- Request California Weights & Measures to work with CaFCP & NIST on dispenser verification

H2 Highway: C&S for Compressed H2 vehicle refueling interface (DRAFT)			
Status: 8/11/04			
	Draft Standards	Applicable Released Standards	Recommendations:
		Gap Analysis Key:	
		 = Gap requiring additional supporting documents for interim	
		 = Gap which can utilize current release C&S until update is available	
		 = No Gap: Applicable C&S already released	
CSA America			
CSA America HGV 4.1-	Compressed Hydrogen Dispensers		Utilize CaFCP Fueling Interface Guidelines until HGV Standards are released
CSA America HGV 4.2-	Hoses and Hose Assemblies for Gaseous Hydrogen Vehicles and Dispensing Systems		Components chosen must be Hydrogen compatible @ applicable pressure range
CSA America HGV 4.3-	Temperature Compensation Systems for Gaseous Hydrogen Vehicle Fueling Stations		Utilize CaFCP Fueling Interface Guidelines until HGV Standards are released
CSA America HGV 4.4-	Breakaway Devices for Hoses Used in Compressed Hydrogen Vehicle Fueling Stations		Components chosen must be Hydrogen compatible @ applicable pressure range
CSA America HGV 4.5-	Priority and Sequencing Equipment for Gaseous Hydrogen Dispensing Systems		Components chosen must be Hydrogen compatible @ applicable pressure range
CSA America HGV 4.6-	Manually Operated Valves Used in Gaseous Hydrogen Vehicle Fueling Stations		Components chosen must be Hydrogen compatible @ applicable pressure range
CSA America HGV 4.7-	Standard for Automatic Pressure Operated Valves for Use in Gaseous Hydrogen Vehicle Fueling Stations		Components chosen must be Hydrogen compatible @ applicable pressure range
CSA America HGV 4.8-	Hydrogen Gas Vehicle Fueling Station - Compressor		Components chosen must be Hydrogen compatible @ applicable P & T range
CSA America HGV 2	Hydrogen Gas Vehicle Fueling Container		Components chosen must be Hydrogen compatible @ applicable P & T range
CSA America PRD-1 HGV	Pressure Relief Devices for Hydrogen Gas Vehicle (HGV) Fuel Containers		Components chosen must be Hydrogen compatible @ applicable Temperature
CSA America FC 51 ULL 2264	Hydrogen Generators Utilizing Fuel Processing Technologies		
Society of Automotive Engineers International			
SAE J2601	Performance requirements for the communications and refueling algorithms of a automotive gaseous and liquid hydrogen dispensers		Utilize CaFCP Fueling Interface Guidelines until SAE Standards are Released
SAE J2579	Recommended Practice for Fuel Systems in Fuel Cell and Other Hydrogen Vehicles		Recommended Practice for Gaseous Fuel Cell Vehicle Safety

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Liquid Hydrogen Fueling

Status:

- Current Codes & Standards surveyed
- Several gaps identified – primarily fueling equipment & protocol - *work is underway to close gaps*

Potential Liquid Recommendations

- Use Best Practice Guidelines until SAE codes become available
- Request California Weights & Measures to work with NIST to develop measurement of fuel fill rate and fuel percentages

H2 Highway: C&S for Liquid H2 vehicle refueling interface (DRAFT)				
Status: 8/09/04				
Draft Standards		Applicable Released Standards		Recommendations:
		<u>Gap Analysis Key:</u>		
			= Gap requiring additional supporting documents for interim	
			= Gap which can utilize current release C&S until update is available	
			= No Gap. Applicable C&S already released	
CSA America				
	CSA is not currently doing work in L2			
Society of Automotive Engineers International				
SAE J2600	L2-L2 Nozzle addition			Utilize BMW/GM L2/L2 Fueling Interface Protocol until SAE Standard Published
SAE J2601	Performance requirements for the communications and refueling algorithms of a automotive gaseous and liquid hydrogen dispensers			Utilize BMW/GM L2/L2 Fueling Interface Protocol until SAE Standard Published
SAE J2579	Recommended Practice for Fuel Systems in Fuel Cell and Other Hydrogen Vehicles	SAE J2579	Recommended Practice for General Fuel Cell Vehicle Safety	
SAE J1000X	Hydrogen Quality Guideline for Automotive Applications (Standard number has not yet been assigned)			Utilize released L2/L2 Guideline
National Fire Protection Association				
NFPA 52	Vehicular Fuel System Code 2005 (incorporates NFPA 57 as well) - LNG, LNH, L2/L2			
NFPA 55	Standard for the Storage, Use and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, Equipment and Tanks (will also incorporate NFPA 55A & 55B)	NFPA 55B	Standard for Liquid Hydrogen Systems at Consumer Sites	
		NFPA 70	National Electrical Code Handbook	
International Codes Council (do not apply to CA)				
ICC Model Building Code	Fuel Gas Code, Ch. 7 Liquid H2 Systems	ICC Model Building Code	Fuel Gas Code, Ch. 7 Liquid H2 Systems	
American Standards and Testing Methods				
ASTM D8511	Subcommittee for C&S on hydrogen and fuel cell vehicles (ASTM D2152) - Standard Test methods and guidelines for gaseous (LNG, LNH, DHE) fuels			Various released standards for H2 impurity constituents

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Blend HCNG Fueling

Status:

- Current Codes & Standards surveyed
- Several gaps identified - *not much work is underway to close gaps*

Potential HCNG Recommendations

- Work with SDOs and ARB to define the percentage range of hydrogen. Key SDOs are SAE and ISO TC197.
- Request CA Weights & Measures to develop methods to measure HCNG fuel fill rate and fuel percentages
- Recommend to DOE to identify SDO to craft standards for HCNG% guidelines

H2 Highway: C&S for Hydrogen- CNG (HCNG) "Blend" vehicle refueling interface (DRAFT)		Status: 8/10/04	
Draft Standards	Applicable Released Standards	Recommendations:	
	<i>Gap Analysis Key:</i>		
	■ Gap requiring additional supporting documents for intake		
	■ Gap which can utilize current release C&S until update is available		
	■ No Gap. Applicable C&S already released		
CSA America			
CSA America NGV 4.1	Compressed Natural Gas Dispensers	CSA America NGV 4.1	Compressed Natural Gas Dispensers
CSA America NGV 4.2	Hoses and Hose Assemblies for Gaseous Natural Gas Vehicles and Dispensing Systems	CSA America NGV 4.2	Hoses and Hose Assemblies for Gaseous Natural Gas Vehicles and Dispensing Systems
CSA America CNG 4.3	Temperature Compensation Systems for Gaseous Natural Gas Vehicle Fueling Stations	CSA America CNG 4.3	Temperature Compensation Systems for Gaseous Natural Gas Vehicle Fueling Stations
CSA America CNG 4.4	Breakaway Devices for Hoses Used in Compressed Natural Gas Vehicle Fueling Stations	CSA America CNG 4.4	Breakaway Devices for Hoses Used in Compressed Natural Gas Vehicle Fueling Stations
CSA America CNG 4.5	Priority and Sequencing Equipment for Gaseous Natural Gas Dispensing Systems	CSA America CNG 4.5	Priority and Sequencing Equipment for Gaseous Natural Gas Dispensing Systems
CSA America CNG 4.6	Manually Operated Valves Used in Gaseous Natural Gas Vehicle Fueling Stations	CSA America CNG 4.6	Manually Operated Valves Used in Gaseous Natural Gas Vehicle Fueling Stations
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Society of Automotive Engineers International			
	No Standards for HCNG fuels		No Standards for HCNG fuels
National Fire Protection Association			
NFPA 52	Vehicle Fuel System Code 2005 (incorporates NFPA 57 as well L-CNG, LNG, LH2, CH2. Present draft considers HCNG's with < 20% H2 equivalent to NG. (need to look at 30% H2 CNG)	NFPA 50A	Standard for Gaseous Hydrogen Systems at Consumer Sites



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Summary

- California does not have a complete package of Codes & Standards available for dispensing CH₂, LH₂ and HCNG fuels
- California authorities could fill gaps for CH₂ dispensing with CaFCP Guidelines until SAE & CSA codes and standards are available
- California authorities could fill gaps for LH₂ dispensing with BMW/GM best practice guidelines until SAE codes and standards are available
- California authorities needs to define the range of hydrogen content to be used in HCNG blends before codes & standards can be established



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